CHAPTER 8

ASPHALT PLANT SUPERVISOR

The Naval Construction Force (NCF) uses various makes and models of asphalt plants in both the Atlantic and Pacific Fleet deployment sites. As an asphalt plant supervisor, you are a key member and share the responsibility for producing a quality mix. You must be aware of all operational functions of the plant and bring to the attention of the Alfa company operations chief any detected problems or potential problems. Additionally, you must be aware of all federal, state, and local regulations and ordinances relating to the operation of the plant, such as air and water pollution restrictions, anti noise requirements, restricted hours of operation, and so forth. Before deploying, contact the COMSECOND/COMTHIRDNCB equipment offices for *Environmental Protection Agency (EPA)* directives,and operator's manuals that relate to the asphalt plant at your prospective deployment site.

ASPHALT PLANT SUPERVISOR RESPONSIBILITIES

This chapter presents the basic information concerning the operations of asphalt plants and the production and uses of bituminous materials. The Seabees need well-qualified personnel to operate and maintain asphalt plants. To ensure personnel are qualified, you must emphasize on-the-job training programs. Also, personnel must gain a thorough understanding of the manufacturers' operator and maintenance manuals.

An asphalt plant is an assembly of mechanical, computerized, electronic equipment where aggregates are blended, heated, dried, and mixed with asphalt to produce a hot-asphalt mix that meets specified requirements. An asphalt plant can be small, large, stationary, or portable. Whatever the size or configuration, every plant can be categorized as either a batch asphalt plant (fig. 8-1), a continuous-flow

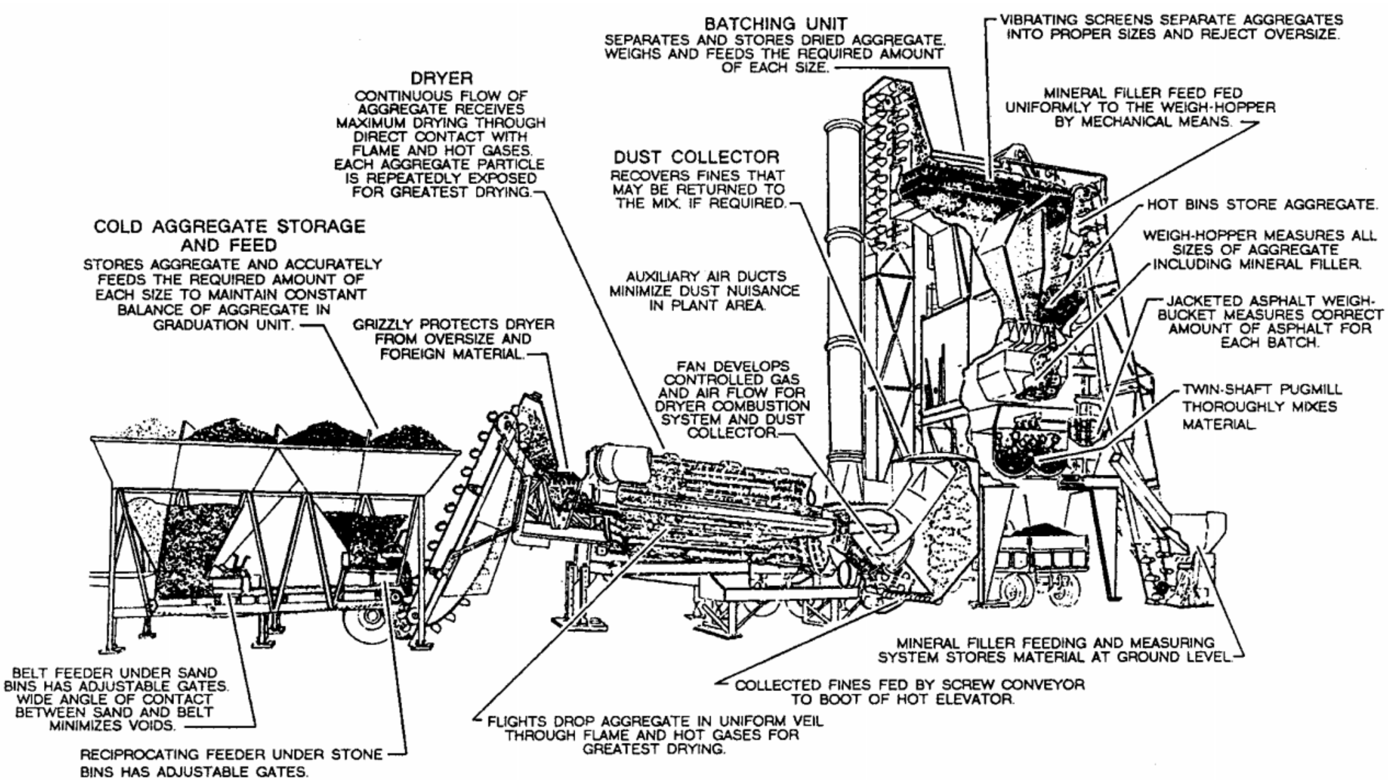

Figure 8-1.—Batch asphalt plant.

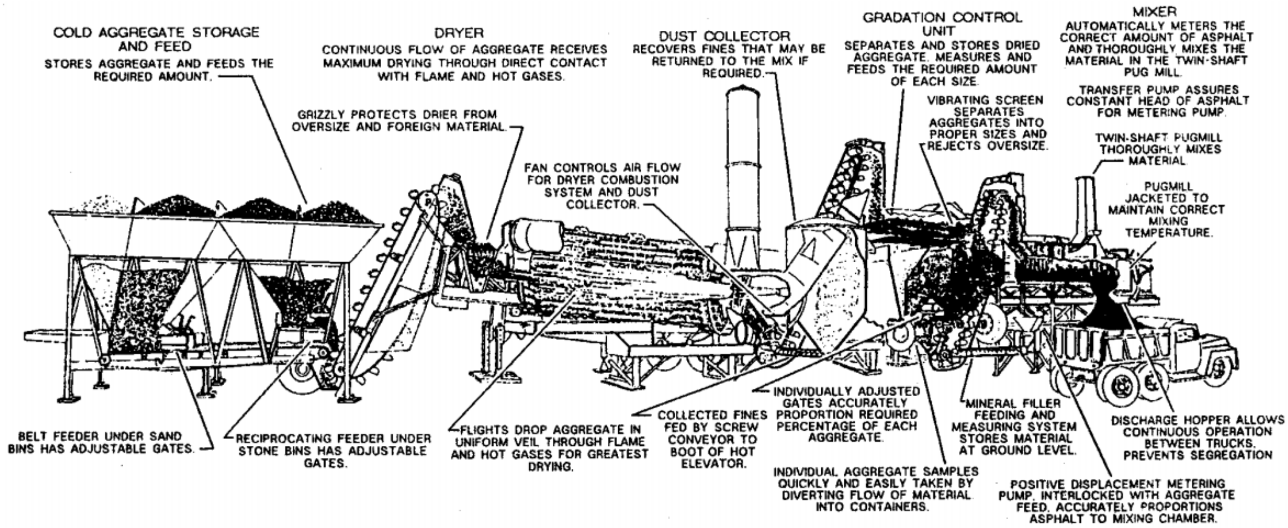

Figure 8-2.—Continuous-flow asphalt plant.

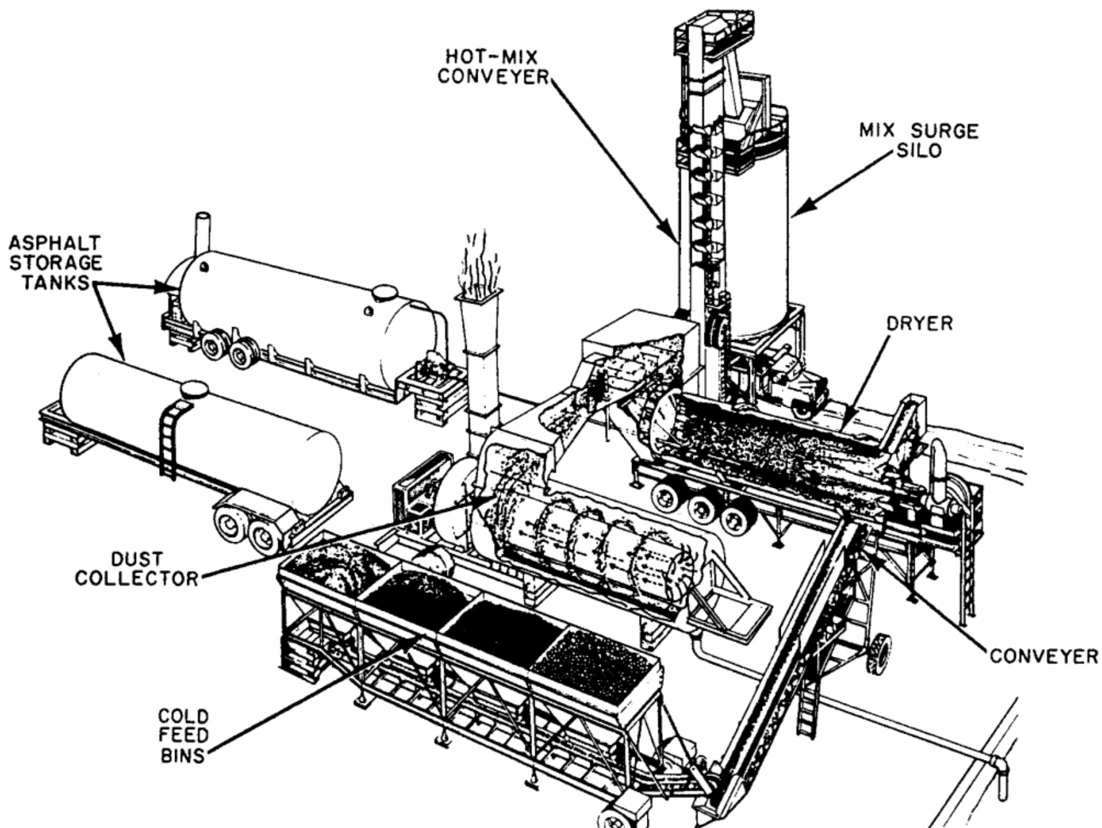

Figure 8-3.—Drum-mix asphalt plant.

asphalt plant (fig. 8-2), or a drum-mix asphalt plant (fig. 8-3).

ASPHALT PLANT OPERATIONS

Batch plants get their name because they produce hot mix in batches; one batch at a time, one after the other. The size of a batch varies according to the capacity of the plant pugmill (fig. 8-4). Batch plants are distinguished from continuous-type plants, such as drum-mixers, which produce hot mix in a steady flow.

Aggregate Cold-Feed System

The aggregate storage and cold feeder system (fig. 8-5) moves (unheated) aggregate from storage into the

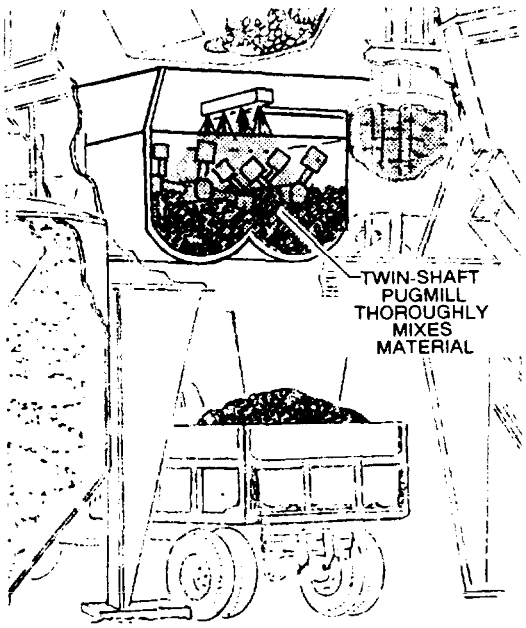

Figure 8-4.-Pugmill

plant. The feeder may be charged by a clamshell or front-end loader. Aggregate feeder units should have controls that can beset and secured to produce a uniform flow of aggregate to the cold elevator.

For a uniform OUTPUT from the asphalt plant, INPUT must be accurately measured. The importance of feeding the exact amounts of each size aggregate into the dryer at the correct rate of flow cannot be overemphasized.

The following conditions ensure a uniform flow of aggregate sizes:

- Correct sizes of aggregate in stockpiles.
- No intermixing of stockpiles.
- Accurately calibrated, set, and secured feeder gates.
- Gates kept free of obstruction.
- No excessive arching in the fine aggregates. Arching can be minimized by using rectangular (rather than square) openings above the feeders or placing

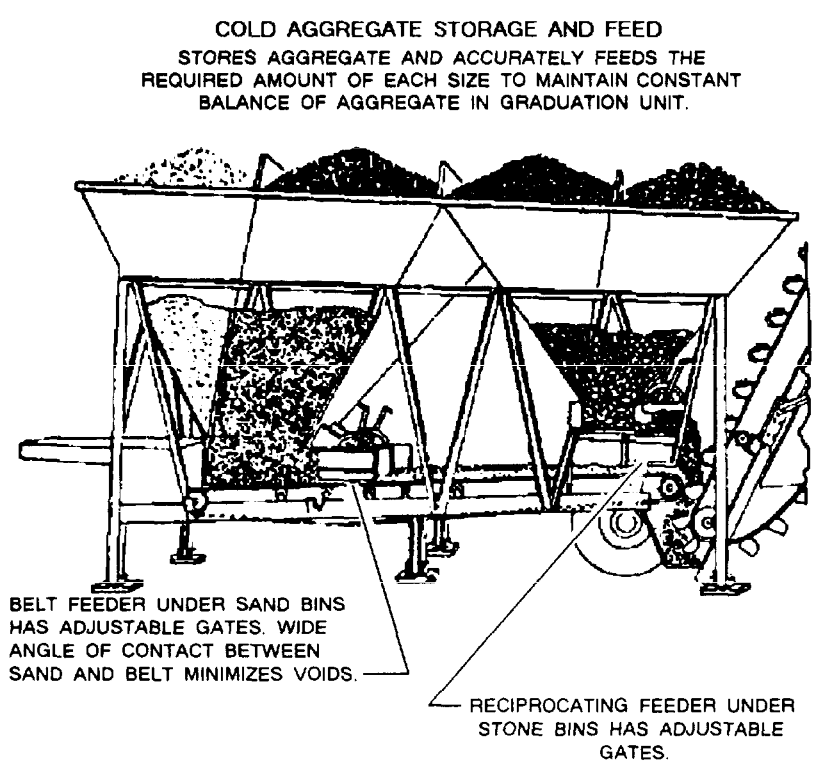

Figure 8-5.-Aggregate storage and cold-feed system.

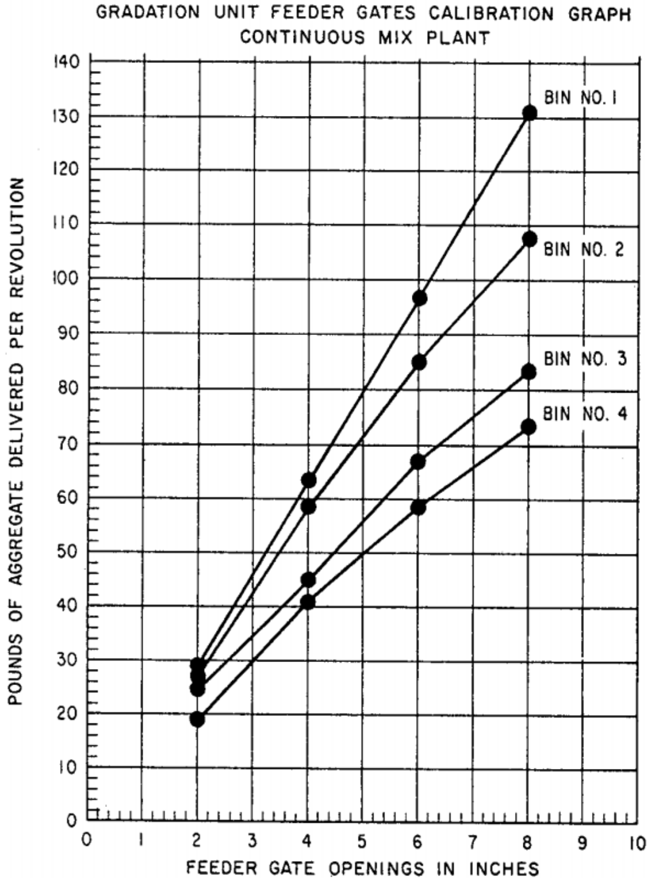

Figure 8-6.-Calibration chart, gradation feeder gates.

vibrators on the outside of the fine aggregate bins, or both. Vibrators should be wired to cut off automatically when the feeder stops. This eliminates excessive packing in the bin.

The following conditions underscore the need for proper cold feeding:

- Wide variations in the moisture content or in the quantity of a specific aggregate at the cold feed may cause a considerable change in the temperature of the aggregate leaving the dryer.

- A sudden increase in the cold feed can overload the screens, creating a carry-over of the fine aggregate into the coarse aggregate hot bins.

- Erratic feeding may cause some bins to overfill while starving others. This can result in the following problems:

1. Layers of variable grading in the hot bin gradation unit storage, especially in the fine bin, resulting in alternating rich and lean batches
2. An overloaded dust collection system
3. A reduced dryer draft

The cold aggregate feeder gates should be calibrated. Most manufacturers furnish approximate calibrations for the gate openings of their equipment. When these are available, they are helpful in making the initial gate setting. But the only accurate way to set gates is by making a calibration chart for each gate, using the aggregate to be used in the mix.

The gate opening (in inches or square inches) is plotted on the chart as the horizontal coordinate, and the pounds of material per revolution of the feeding mechanism (or pounds per minute) is the vertical coordinate. When the calibration chart is being prepared, the gate is set, usually at 25 percent or less of the total opening, and the feeder is started. When the feeder is running normally, the material is measured into a tare container and weighed at known time intervals (or number of revolutions). This gives one point on the calibration chart. The operation is repeated for three or more gate openings and the points connected on the chart (fig. 8-6). After the gates have been calibrated and locked, minor adjustments may be necessary to assure uniform production.

When the gates discharge on to the belt conveyer, their output may be checked by closing all of the gates except one, which is set at one of the calibration points. When the gates cannot be closed completely, it may be necessary to stop the feeder or disconnect it if it is mechanically driven.

The plant is started and brought to normal operating speed. Then the plant is stopped and the material from a measured section of the belt is removed and weighed, using care to remove all fines.

The weight of the material, divided by the length (in feet) of the belt section, multiplied by the belt speed (in feet per minute), will give the amount of material delivered per minute from the gate opening. The material from other gate openings is determined in the same manner and the gate calibration chart plotted as described above.

When variable speed drives are used to control belt feeders, calibration is simplified. The gate opening can be estimated, and the speed of the belt can be increased or decreased to deliver the required percentage and tonnage of aggregate.

In calculating the output of a gate for a given opening, deduct the weight of the surface moisture on the aggregate being weighed. This is very important

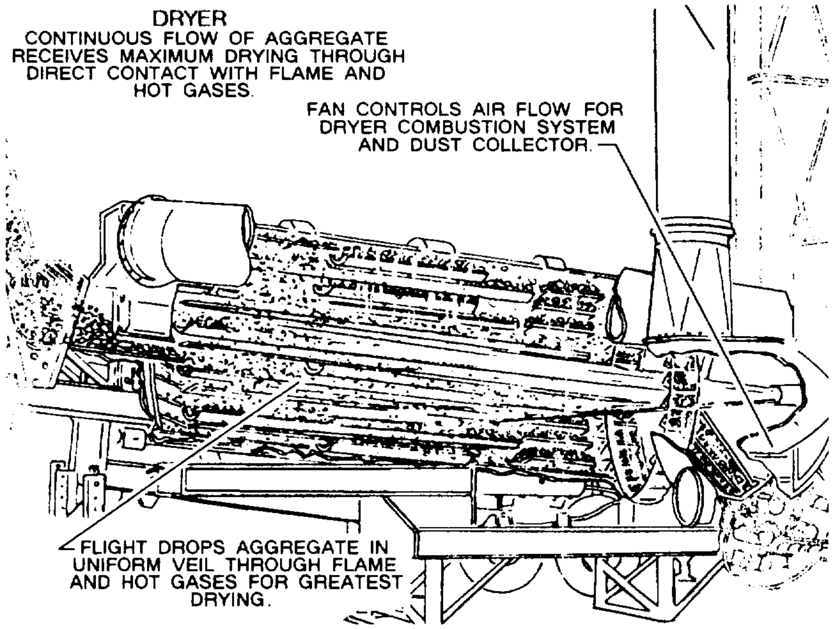

Figure 8-7.-Dryer.

when calibrating gates through which fine aggregates are flowing.

For uniform flow, gates that feed coarse aggregate should not be set at a height less than 2 1/2 to 3 times the largest aggregate size; for example, if a gate is feeding aggregate that has a maximum size of 1 inch, the gate should not be set at less than 2 1/2 or 3 inches. Sometimes it may be necessary to restrict the opening width to provide the necessary opening height.

Before you set the cold-feed gates, the production volume of the plant in normal operation must be determined. this can be estimated from the plant size (dryer, screening, and mixing capacities) and mixing cycle time. Then, using the gate calibration charts, each gate is set to deliver its share of the desired volume of aggregate.

Grading of the individual cold aggregate is determined by sieve analysis. The percentage of each size of aggregate to be used is calculated by trial and error.

The proportions required on the basis of these percentages will determine the gate settings. These settings should be checked by the same method used in calibrating the gate originally.

The setting should be considered tentative because the cold aggregate may vary in grading and moisture with the weather and other conditions that will affect its bulking and flow.

The hot bins should be watched carefully and the cold aggregate feeders regulated to see that they do not run out of material or overflow.

Dryer

From the aggregate cold-feed system, aggregates are delivered to the dryer. The dryer (fig. 8-7) is a revolving cylinder in which the aggregate is dried and heated by an oil or gas burner. The cylinders used range from 3 to 10 feet in diameter and from 15 to 40 feet in length. A cylinder is usually equipped with longitudinal cups or channels (called lifting flights) that lift the aggregate and drop it in veils through the burner flame and hot gases. The slope of the cylinder, its speed, diameter, length, and the arrangement and number of flights control the length of time required for the aggregate to pass through the dryer.

The dryer performs two functions: (1) it removes moisture from the aggregate and (2) it heats the aggregate to mixing temperature.

The dryer includes an oil or gas burner with a blower fan to provide the primary air for combustion of the fuel and an exhaust fan to create a draft through the dryer. For efficient dryer operation, the air that is combined with the fuel for combustion must be in balance with the amount of fuel oil being fed into the burner. The exhaust fan creates the draft of air that carries the heat through the dryer and removes the moisture. Imbalance among these three elements causes serious problems. With fuel oil, lack of sufficient air or excess flow of fuel oil can lead to incomplete combustion of fuel. The unburned fuel leaves an oily coating on the aggregate particles–a coating that can adversely affect the finished mixture.

Lack of balance between the blower air and draft air velocities can create hack pressure within the dryer drum, causing *puff back* at the burner end. Puff back indicates that the draft is not sufficient to accommodate the air pressure being introduced by the burner blower. The solution is to increase the draft or to reduce the pressure of the blower air.

Dryer burners using natural gas or liquid petroleum gas rarely develop combustion problems; however, an imbalance between gas pressure, combustion air, and draft can occur. Make sure the gas burner you use is the correctly type for the pressure of the gas available.

The temperature of the aggregate, not the asphalt, controls the temperature of the mix. Overheating the aggregate can harden the asphalt during mixing. Underheating the aggregate is difficult to coat with asphalt and the resulting mix is difficult to place; therefore, a pyrometer, which is a reliable and accurate temperature-measuring device, should be installed in the dryer discharge in full view of your burner operator.

The pyrometers are sensitive instruments, designed to measure the very small electrical current induced by the heat of the aggregate passing over the sensing element. The pyrometer must be completely shielded from the heat and plant vibrations. The head of the device is usually located several feet away from the dryer and is connected to its sensing elements by wires. Any change in the connecting wire length, size, splice, or coupling will affect the calibration of the device and it must be recalibrated.

Two types of pyrometers are used. They are as follows: (1) the indicating pyrometer, which is usually located at the discharge chute of the dryer, and (2) the recording pyrometer. The recording head of this instrument is usually located in the plant control room.

The major difference between the indicating pyrometer and the recording pyrometer is that the indicating pyrometer gives a dial or digital reading, and the recording pyrometer records aggregate temperatures on paper in graph form providing a permanent record. Both types of pyrometers are quite similar in operation. Both pyrometers have a sensing element; that is, a shielded thermocouple that protrudes into the main hot-aggregate stream in the discharge chute of the dryer.

Pyrometers should be cleaned periodically. Dust accumulating on them may cause a time lag in temperature measurement.They should also be checked frequently for accuracy. A simple way to do this is to put the sensing element of the pyrometer, together with an accurate thermometer, in an oil or asphalt bath. Being cautious of the flash point for the bath, slowly heat the oil or asphalt and compare readings from the pyrometer and thermometer. These readings should be taken at temperatures below, through, and above the expected operating temperature range.

Another means to check the accuracy of a temperature-indicating device is to take two shovel loads of hot aggregate from the dryer discharge chute and dump them in a pile on top of each other. The top shovel load of hot aggregate keeps the bottom shovel load of aggregate hot while the temperature is taken. Inserting the entire stem of an armored thermometer into the hot aggregate pile will give a temperature reading that can be compared to the reading on the pyrometer. Several thermometer readings may be necessary to get accurate temperature data.

A moisture check of the hot aggregate can be performed at the same time a temperature indicator check is performed. From the two shovel loads of aggregate, observe the aggregate for escaping steam or damp spots. These are signs of incomplete drying or porous aggregate releasing internal moisture which may or may not be a problem, Another procedure used to check the moisture content is to take adry, clean mirror, shiny spatula, or other reflective item and pass it over the aggregate slowly and at a steady height. Observe the amount of moisture that condenses on the reflective surface. With experience, you will be able to detect excessive moisture consistently. These quick-moisture checks are useful in determining whether a more precise laboratory moisture test should be preformed.

Dust Collector

Manufacturers have designed asphalt plants to have equipment that restrict the escape of pollutants from the plant. Even so, during the operation of an asphalt plant, some gaseous and particulate pollutants may escape into the air. These pollutants must be controlled and limited to meet established clean air regulations. As the supervisor, you must be fully aware and familiar with the local laws concerning air pollution.

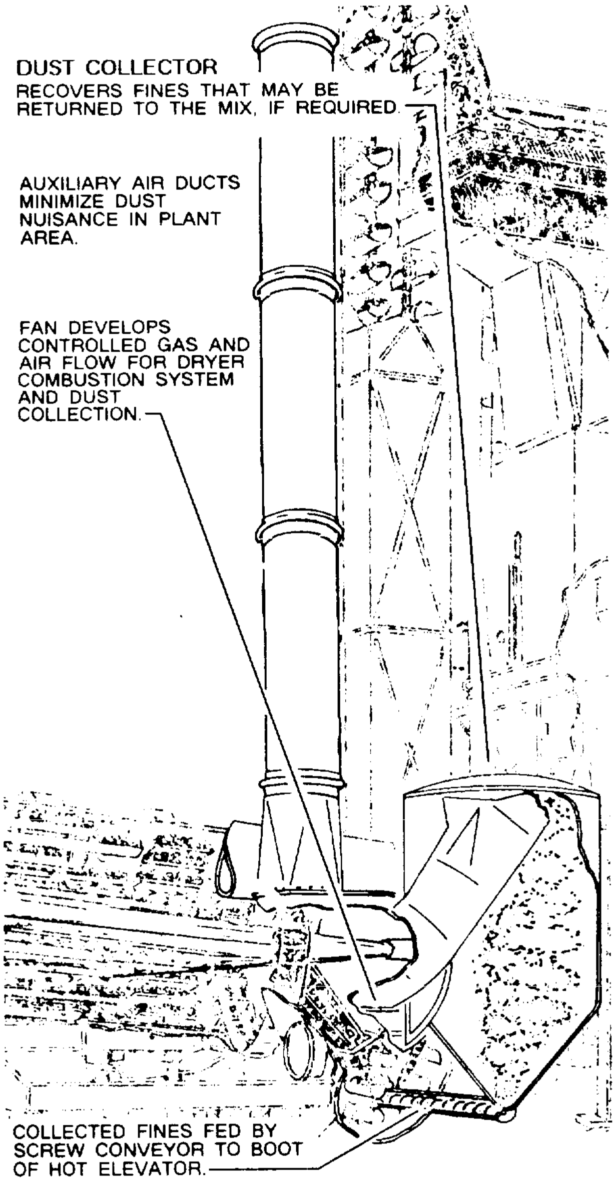

Figure 8-8.–Dust collector.

A major air pollution concern at an asphalt plant centers around the combustion unit. Dirty, clogged burners and improper air-fuel mixtures result in excessive smoke and other undesirable combustion products; therefore, close attention to the cleanliness and adjustment of the burners and accessory equipment is very important.

Another source of air pollution is aggregate dust. The greatest dust emissions from the plant come from the rotary dryer. Dust collectors are installed at this location to reduce dust emissions to a level that meets anti-air-pollution requirements.

Most dust collectors (fig. 8-8) are centrifugal (cyclone) units, either horizontal or vertical with single or multiple shells. Dust particles enter the top of the dust collector in the current of draft air from the dryer, drawn by the fan(s) that pull(s) the flame and the hot gases through the dryer. In the collector, the dust-laden air is forced into a whirling motion.

Heavier dust particles in the exhaust gas stream are separated by centrifugal force against the collector shell and are carried to the lower outlet. If the collector works efficiently, the finer dust that remains in suspension is carried out the exhaust stack with the air. The fines collected at the bottom of the cyclone are normally picked up by a dust-return auger and returned to the plant or wasted.

When required by specifications, a baghouse or wet wash system is added to the dust-collecting system. Several types of wet systems are used. They usually consist of a short tower, with or without baffles, or multiple horizontal tubes with spirals. The washer swirls the high-velocity exhaust coming from the dust collector through a fog and a fine spray to wash the gas. The dampened fines are thrown to the sides by centrifugal force. The material washes down the sides and discharges, with the water, out the bottom of the washer. The wastewater containing the dust must be properly handled to prevent it from becoming another source of pollution. Use of a wet wash system requires a large source of water. Also, the output of the fan in the dust collector must be increased by 10 to 20 percent because of pressure loss in the tower.

The baghouse is a large metal housing, containing hundreds of synthetic, heat-resistant fabric bags. The bags are usually silicone-treated to increase their ability to collect and retain very fine particles of dust. The function of the baghouse is similar to the function of a vacuum cleaner. A large vacuum fan creates a suction within the housing that draws in dirty air and filters it through the fabric of the bags. A typical unit may contain as many as 800 bags to handle the huge volume of exhaust gases from the aggregate dryer. Eventually, they accumulate into what is called a *"dust cake"* that must be removed before it reduces or stops the flow of dirty air through the filter. Several methods for cleaning the bags in the baghouse are used; however, the most commonly used methods are as follows: flex the bags, back flush the bags with clean air, or flex and back flush the bags. The Jet-Pulse system is another method which is similar to the back flush in that it produces a pulse of positive pressure within the bag to dislodge the "dust cake." Dust removed from the bags drops into an auger at the bottom of the baghouse and is normally

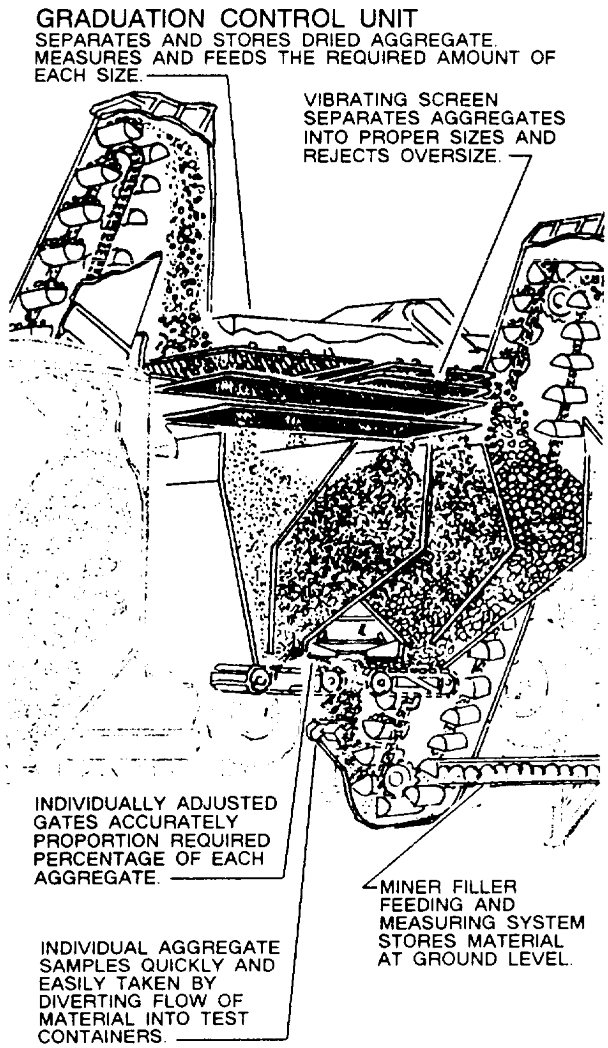

Figure 8-9.-Gradation control unit.

transferred to a storage silo. This material is often used in the hot mix.

When the material removed from the dust collector can be recombined satisfactorily with the aggregates in the mix, some or all of it may be returned to the plant. The amount returned depends upon the combined grading of the finished mix. When the collected dust is unsatisfactory or is prohibited by the mix specifications, it is removed from the bottom of the collector and wasted.

Hot Screens

After the aggregates have been heated and dried, they are carried by a hot elevator to the gradation unit, In the gradation unit, the hot aggregate passes over a

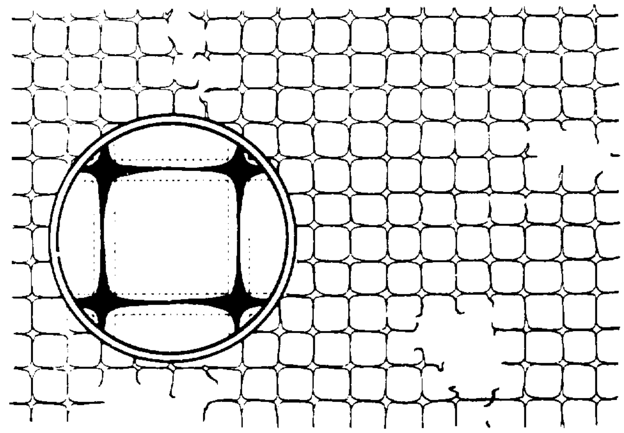

Figure 8-10.-Screen wear.

series of screens. The function of the screens is to separate the hot aggregate into the specified sizes accurately and deposit those sizes in hot bins.

The gradation control unit (fig. 8-9) or screening unit includes a set of several different-sized vibrating screens. The top screen is a scalping screen that rejects and carries off oversized aggregates. This is followed by one or two intermediate-sized screens, decreasing in size from the top to bottom. The very bottom screen is normally a sand screen. The effective screening area must be large enough to handle the maximum amount of feed delivered to separate the hot aggregates properly; therefore, the capacity of the screens should be checked against the capacity of the dryer and the capacity of the pugmill.

When too much material is fed to the screens or the screen openings are plugged, many particles that should pass through ride over the screen and drop into a bin designated for larger sized aggregate. When screens are worn (fig. 8-10) or torn, resulting in enlarged openings and holes, oversized material will go into bins intended for smaller sized aggregate. Fine aggregate misdirected into bins intended for larger aggregate is know as *"carry-over."*

Carry-over can cause a lack of uniformity in the aggregate gradation and in the mixture. Additionally, excessive carry-over adds to the amount of fine aggregate in the total mix, thus increasing the surface area to be coated with asphalt. Excessive carry-over, or its fluctuations, can be detected by a sieve analyses made from the contents of the individual hot bins and must be corrected immediately. Corrective measures include the cleaning of screens, the regulation of the quantity of material coming from the cold feed, or a combination of both. Some carry-over is permitted in normal screening;

however, the permissible amount in each bin is usually specified.

Daily visual inspection of the screens for cleanliness is recommended, preferably before the start of operation. When conditions warrant, the screens should be cleaned.

NOTE: Always make sure the bolts securing the screens are tight.

Hot Bins

Hot bins are used to store the heated and screened aggregates temporarily in the various sizes required. Each bin is an individual compartment or a segment of a large compartment divided by partitions. A properly sized hot-bin installation should be large enough to prevent running out of material when the mixer is operating at full capacity. Bin partitions should be tight, free from holes, and of sufficient height to prevent intermingling of the different size aggregates.

Hot bins usually have indicators that tell when the aggregates fall below a certain level. These indicators may be either electronic or mechanical. Each hot bin should be equipped with an overflow pipe to prevent excess amounts of aggregate from backing up into the other bins. The overfill pipes should be set up to stop overfilling of the bins. When a bin overfills, the screen above the bin rides on the aggregate, resulting in heavy carry-over and possible damage to the screen. Overflow vents should be checked frequently to ensure they are free flowing.

Sometimes, very fine aggregate particles build up in the bin corners. When this buildup of aggregate collapses, it can result in an excessive amount of fines in the mix. This rush of fine materials normally occurs when the aggregate in the bin is drawn down too low. This condition can be controlled by having fillet plates welded in the bin corners to eliminate the 90-degree angles and by maintaining the proper aggregate level in the bin.

Other potential obstacles to obtaining a good mix includes a shortage of aggregate in one bin or excess in another bin, worn gates (at the bottom of the bins) allow leakage of aggregate, and sweating of the bin walls. These obstacles must be overcome. Bin shortages or excesses can be corrected by adjusting the cold feed. Sweating occurs when moisture vapor in the aggregate and in the air condenses on the bin walls. his usually happens only at the beginning of the day's operation or when the coarse aggregate is not thoroughly dried.

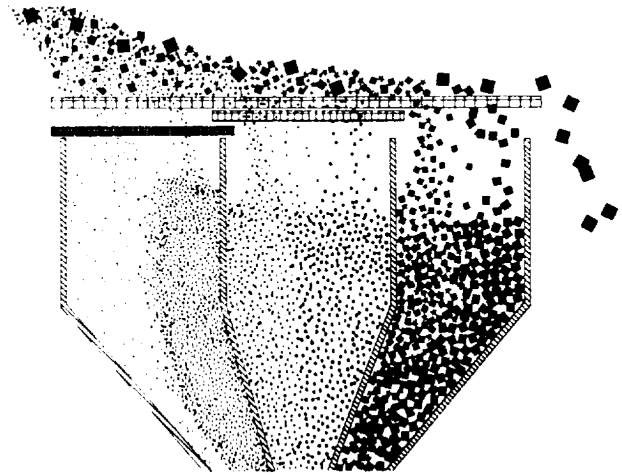

Figure 8-11.-Segration of material in the bot bins.

Sweating may accumulate dust that, when released suddenly, will add unwanted fines in the mix.

Hot-Bin Sampling

Most modern hot-mix asphalt plants are equipped with devices for sampling hot aggregate from the bins. These devices vary in design but usually serve to divert the flow of aggregate from the feeders, or gates, under the bins into sample containers. On continuous-flow plants, the best place to obtain a sample is from the feeder gates as the material is deposited onto the elevator leading to the pugmill. Sampling facilities must be constructed and located so that the samples obtained will be representative of the material in the bins.

From the flow of aggregate over the screens, the finer aggregates fall to the near side of the bins and coarser aggregates fall to the far side (fig. 8-11). When the aggregate is drawn from a bin by opening a gate at the bottom, the flow of aggregate consists predominantly of fine aggregate at one edge and coarse aggregate at the other; therefore, the position of the sampling device in the flow of aggregate determines whether the sample will be composed of the fine portion, the coarse portion, or will be an accurate representation of all the aggregate in the bin. This condition is critical in the bin that contains the fine aggregate since the asphalt required in the mix is influenced heavily by the aggregate from this bin.

Stratification (vertical layering) of sizes in the fine bin may be caused by variation of grading in the stockpiles or by erratic feeding of the cold aggregate. When this form of segregation exists, representative

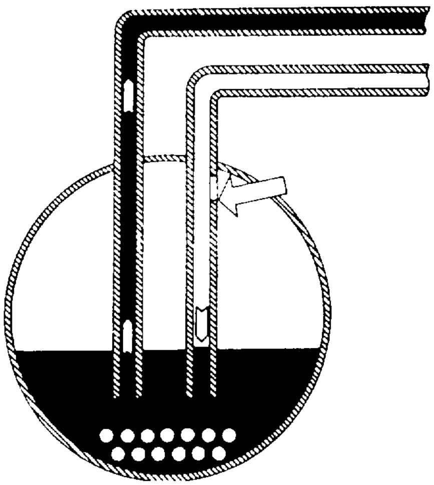

Figure 8-12.-Asphalt return line.

samples cannot be obtained even when the sampling device is used correctly.

Asphalt Heating and Circulation

Provisions should be made for the circulation of the asphalt through the feeding and storage system. All storage tanks, transfer lines, and pumps should have heating coils and/or jackets to maintain the asphalt at the required temperature.

Return lines discharging into the storage tanks should be submerged below the asphalt level in the tank to prevent oxidation of the asphalt. When the pump is reversed, two or three vertical slots should be cut in the return line within the tank to break the vacuum in the lines. The slots should be cut above the high level mark of the stored asphalt (fig. 8-12).

To assure temperature control of the asphalt, you should place an armored thermometer or a pyrometer with a recorder in the asphalt feed line at a location near the discharge valve at the mixer unit. Also, the asphalt storage tank should be equipped with a recording thermometer, having a minimum time range of 24 hours.

An approved valve or spigot should be installed in the tank or in the circulating system to provide a means for sampling the asphalt. Sufficient material must be drawn and wasted before the sample is taken to ensure the material obtained is truly representative of the storage supply.

When the temperature of the asphalt is maintained by circulating heating oil, the level of the hot oil in the reservoir of the heating unit should be inspected frequently. If the hot-oil level falls, check for leakage of the hot oil into the stored asphalt.

Temperature of Mixture

Both asphalt and aggregate must be heated before they are combined in the pugmill. The asphalt is heated to make it fluid enough to coat the aggregate particles. The aggregate is heated to make it dry and hot enough to keep the asphalt in a fluid state while it is coating the particles.

Asphalt is a thermoplastic material that decreases in viscosity with increasing temperature; however, the relationship between temperature and viscosity may not be the same for different sources or types and grades of asphalt material.

The temperature of the aggregate controls the temperature of the mixture, and a mixing temperature normally is specified based on factors relating to placement and compacting conditions. Another consideration is the temperature required to dry the aggregate sufficiently to obtain a satisfactory mix.

Mixing should be accomplished at the lowest temperature that provides complete coating of the aggregate particles and a mixture of satisfactory workability. Table 8-1 provides a guide for suggested asphalt temperatures ranges.

Mineral Filler

Mineral filler is a fine material (dust) that passes through the No. 200 sieve during a sieve analysis. Mineral filler is normally part of the asphalt mix design, used to fill in the voids of the aggregates. Mineral fillers commonly used are the following: portland cement, pulverized limestone (limestone dust), silva, and hydrated lime.

High production plants often have a separate feeding system for introducing mineral filler into the asphalt mix. Part of this system is a storage silo that maintains several days supply of mineral filler. A receiving hopper, screw conveyer, and dust elevator are used to charge the storage silo, and a vane feeder meters the filler introduced into the mix. The ultimate choice of this system is usually dependent on the availability of bulk filler and their price in relation to bagged fines.

In plant operations where the volume of filler required does not justify a bulk silo, a bag feeding system is used. This system consists of a ground-mounted feeder, dust-tight elevator, surge hopper, vane feeder or screw conveyer, and an overflow chute.

Table 8-1.-Suggested Asphalt Temperature Ranges

Type and Grade of Asphalt	Pugmill Mixing Temperature of Aggregates*	Distributor Spraying Temperature
Asphalt Cements		
(For Open-Graded Mixes, Types I & II)**		
40–50	225°F–310°F	
60–70	225°F–305°F	
85–100	225°F–300°F	
120–150	225°F–300°F	
200–300	225°F–300°F	
(For Dense-Graded Mixes, Types III-VIII)**		
40–50	275°F–350°F	
60–70	265°F–330°F	
85–100	255°F–325°F	
120–150	245°F–325°F	
200–300	225°F–300°F	
(For Distributor Spray Applications)		
40–50***		300°F–410°F
60–70***		295°F–405°F
85–100		290°F–400°F
120–150		285°F–395°F
200–300		275°F–385°F
Liquid Asphalts		
RC, MC, and SC Grades		
30	60°F–105°F	
70	95°F–140°F	
250	135°F–175°F	
800	165°F–205°F	
3000	200°F–240°F	
Asphalt Emulsions		
RS-1	****	75°F–130°F
RS-2	****	110°F–160°F
MS-2	50°F–140°F	100°F–160°F
SS-1	50°F–140°F	75°F–130°F
SS-1h	50°F–140°F	75°F–130°F
RS-2K	****	75°F–130°F
RS-3K	****	110°F–160°F
CM-K	50°F–140°F	100°F–160°F
SM-K	50°F–140°F	100°F–160°F
SS-K	50°F–140°F	75°F–130°F
SS-Kh	50°F–140°F	75°F–130°F

*The temperature of the aggregates and asphalt immediately before mixing should be approximately that of the completed batch.

**Mix Type III is intermediate between dense- and open-graded mixes. As the gradation of the mix changes from dense-graded to open-graded, the mixing temperature should be lowered accordingly.

***Not normally used for spray applications in pavement construction.

****Not used for mixing.